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Innovations in Sustainable Food Security: A deliberate approach to eradicate Hunger and Malnutrition in NIGERIA

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ABSTRACT

There is said to be food security when everyone in spite of their race, belief, status and geographical location has good access to healthy, nutritious and desirable food at any point in time. This indeed has not been obtainable in Nigeria as there is still a good number of people who don't have access to healthy foods. To ensure the eradication of hunger and malnutrition in Nigeria, there has to be an intentional and deliberate attempt to treat the root causes of food scarcity, under/over utilization, instability and unavailability of food. The root causes which include: lack of access to technologies that improve productions, climate change, poor soil management practices, insurgencies, transportation difficulties, poverty, ban on foreign importation, poor pest control techniques, inadequate water supply, disease outbreaks, food wastage and lack of adequate preservation facilities. To solve the problem of food insecurity in Nigeria, innovations to sustainable food security such as aeroponics, aquaponics, hydroponics, tissue culture, selective breeding, genetic engineering, direct seeding and biofortification must be recognized and implemented. Furthermore, food processing and preservation technologies which are high pressure processing, high pressure thermal processing, pulsed electric field processing, cool plasma and ultraviolet light processing should be practiced and also insurgencies and poverty issues should be well addressed.

Keywords: food security, production, processing, biofortification, technology, innovation

INTRODUCTION

Although the right to food received extensive international attention during the 20th century, 30 million people in African still require emergency food aid in any given year and 60% of the World Food Program's (WFP) work today takes place in Africa. Millions of people around the globe are unable to purchase or have access to sufficient food to themselves and their families. A more strategic approach is necessary to ensure effective regional and national policies with regards to food security.

The FAO (2003)[1], define a state of food security as "Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and

nutritious food which meets their dietary needs and food preferences for an active and healthy life."

Food security is a measure of the availability of food and individual's ability to access it. There is said to be food security when everyone in spite of their race, belief, status and geographical location has access to healthy, nutritious and desirable food at any point in time.

Up to the mid 1970's discussions about food security, the primary focus was on the need to produce more food and to distribute it better. Discussion prioritized the total availability of food



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calories at the national and global level as the primary means to address malnutrition. [2]

Today, According to FAO, 2008; Gibson, 2012 and Ingram 2011[3,4,5], the concept of food security is generally understood to incorporate four main components or framed in four dimensions:

1. Availability of Food: food with enough nutritional value & sufficient quality needs to be available to people for their consumption. This can be affected by:

- **Production:** how much and what types of food are available through food that is produced and stored locally.
- **Distribution:** how food is made available (physically moved), in what form, when, and to whom.
- **Exchange:** how much of food that is available can be obtained through exchange mechanisms such as barter, trade, purchase, or loans.

2. Access to Food: Individuals and households must be able to acquire sufficient food to be able to eat a healthy, nutritious diet, or have access to sufficient resources needed to grow their own food (e.g. land) which can be affected by:

- **Affordability:** The ability of individuals, households or communities to afford the price of food or land for producing food, relative to their incomes.
- **Allocation:** the economic, social and political mechanisms governing when, where, and how food can be accessed by consumers and on what terms. For example, food may

be unequally allocated according to age and gender within households.

- **Preference:** social, religious, and cultural norms and values that influence consumer demand for certain types of food (e.g. religious prohibitions or the desire to follow a specific dietary pattern such as vegetarianism).

3. Food use/utilization. People must have access to a sufficient quantity and diversity of foods to meet their nutritional needs but must also be able to eat and properly metabolize such food. This can be effected by:

- **Nutritional value:** the nutritional value provided by the foods that are consumed, as measured in calories, vitamins, protein, and various micronutrients (e.g. iron, iodine, vitamin A).
- **Health status:** the effect of disease (e.g. HIV/AIDS or diarrhoea) on the ability to consume the food and absorb and metabolize its nutrients.
- **Food safety:** access to food free from food spoilage organisms or from toxic contaminants introduced during the production, processing, packaging, distribution or marketing of food; and from food-borne diseases such as salmonella.
- **Preparation and consumption:** the resources (e.g. cooking tools and fuel), knowledge and ability to prepare and consume food in a healthy and hygienic way.

4. Food Stability. Food may be available and accessible to people who are able to utilize it effectively, but to avoid increases in

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malnutrition and in order for people not to feel insecure, this state of affair needs to be enduring rather than temporary or subject to fluctuations.

It is not enough for food to be produced but has to be available, accessible, well-utilized and properly managed and preserved.

Causes of food Scarcity

To ensure food security, there has to be an intentional and deliberate attempt to treat the root causes of food scarcity, under/over utilization, instability and unavailability.

The root causes which include:

- Lack of access to technologies that improve food production: The benefits of new technologies are particularly seen in the use of biological, microbiological and technical knowledge. Biotechnology is the use of scientific biological method to improve crops in the development of fields such as agriculture. For instance development of crops that require less water thereby reducing the need for irrigation and the use of micro- propagation for crop plant development.
- Climate change: Nigeria's agriculture and food security is more than 90% dependent on weather and climate element especially rainfall, humidity, wind and evapo-transpiration. These extreme weather events are not only intensifying but also occurring more frequently in many parts of Nigeria. E.g. drought now persists in many parts of Nigeria and farmers have constantly recurring stories of losses in their agricultural productivity.
- Poor soil management practices: Accessing fertilizer recommendation for specific crops are important to farmers. These recommendations exist for some crops in Africa and in Nigeria. E.g. Potato yields in some African countries such as Nigeria but not in others because their soil is below the optimal of soil fertility. Potato is a heavy nutrient feeder and fertilizer recommendation for these crop would provide an avenue for optimal use while guarding against its losses.
- Disease outbreaks: For instance, COVID-19, a coronavirus became pandemic in the year 2020. This pandemic met most countries unawares and unprepared and at such, threw them off-balance. By the time they could find their feet, many lives have been lost.
- To this regard, adequate preparations and plans must be made towards the aspect of food security in order to guide against a future unforeseen outbreak of disease or disasters which may claim the lives of animals and crops.
- Inadequate water supply: The Nigeria /Chad border conflict results from scarcity of resources. Lake Chad is drying up very fast and fishing yields are failing.
- Poor pest control techniques: Corn that has always had the need for external application of pesticide always had short comings, hence the need for the use of genetic



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engineering to raise plants with in-built pesticides.

- Ban on foreign importation: Ban on importation of foreign foods like rice from china has led to scarcity and price inflation.
- food wastage,
- transportation difficulties,
- lack of adequate preservation facilities,
- insurgencies and militant activities,
- poverty,

Furthermore, globally acceptable innovations which will totally help eradicate these root causes above should be quickly implemented.

Food security also has to do with the availability of foods with moderate amounts of nutrients. The World Health Organization (W.H.O) noted that essential nutrients are crucial in supporting a person's reproduction, good health and growth. They divide these nutrients into 2 categories: Macro and Micro nutrients.

Lack of these nutrients can lead to malnutrition. Malnutrition undermines a person's ability to lead a healthy life and occurs when a person is not able to obtain the right variety of nutrients in the right amounts from their diet. It is an umbrella term that includes over-nutrition (an excess of food energy), under-nutrition (a lack of food energy and macronutrients such as protein), and micronutrient deficiencies (insufficient micronutrients such as iron, vitamin A or iodine).

No country is free from malnutrition, and most countries experience multiple burdens

of malnutrition. E.g. some countries like Nigeria and U.S are battling with obesity due to high carbs present in their foods.

It has been estimated that by 2050, there will be 9 billion people to be fed globally. If proper strategies are not put in place and commendable innovations not welcomed, the world may suffer shortage in food supply.

The second Sustainable Development Goal (SDG 2) calls on countries to “end hunger, achieve food security and improved nutrition and promote sustainable agriculture” by 2030. Composed of eight targets, SDG 2 unites hunger, food security, nutrition and sustainable agriculture under a single objective, compelling the international community to move towards an understanding of how they are interrelated and promoting integrated policy approaches and actions. The start of the 2030 Agenda coincided with the launch of the United Nations Decade of Action on Nutrition (2016–2025), adding impetus to joint efforts at eradicating hunger and preventing all forms of malnutrition worldwide [6].

Many people feel time is right to fall back to traditional and indigenous food security mechanisms. These methods are cheap, cost effective and reliable and they can be dependable for Nigeria's teeming population.

Over the recent years there has been growing interest in Nigeria to strengthen and intensify local food production in order to mitigate the adverse effect of national food shocks and food prices volatilities.

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Consequently there is much attention toward kitchen gardens as a strategy to enhanced food security and nutrition. Kitchen garden's economic value and their impact on food security, nutrition and economic growth in crisis and post-crisis remain undefeated.

Improvements in food production with adequate nutritional values and disease resistant strains should also be integrated globally, especially in developing countries and in Nigeria.

Innovations to Sustainable Food Security

To improve the quality and quantity of food production, the following methods should be vigorously implemented:

1. **Hydroponics, Aquaponics and Aeroponics:**

These are methods used for growing certain plants. They do not involve the use of soil. These methods require the use of culture solution containing macronutrients and micronutrients. The culture solution is aerated to provide sufficient oxygen for respiration.

- Hydroponics is a method which involves the use of water containing dissolved nutrients to grow plants.
- Aquaponics is a method where fish and plants are grown in a symbiotic environment. The survival of each specie depends on the other. The waste water from the fish is used to grow plants, in the process of the growth of plant, nitrifying bacteria converts ammonia present in the waste water to nitrites and from nitrites to nitrates which are absorbed by the plant for their

growth. Then, the water is re-circulated back to the fish pond.

- Aeroponics is a modified method of hydroponics whereby nutrient solutions are made to diffuse through to the roots of plants.

Vegetables like spinach, lettuce, tomatoes and chilies can be cultivated using hydroponics and aeroponics methods [7]. Both can control the light intensity and temperature to ensure that the environmental factors are at an optimum level for maximum growth. Moreover, plants achieve faster growth because the culture solution provide nutrients that constantly can be absorbed by the roots and scarcity of water needed for optimum growth is overruled.

2. **Tissue culture:** Tissue culture is a method used to propagate plant cells, tissues or organs in a culture media containing necessary nutrients under aseptic and controlled physical conditions. This method gives rise to young plants that are genetically identical to the parent plant and produces the young plants in large numbers.

3. **Selective breeding:** This method involves the use of choice organisms with desirable genetic attributes to produce offspring with similar or improved attributes.

Breeding of plants consists of using different plants with beneficial qualities such as high nutritional contents, shorter maturity time, higher yields and higher resistance to diseases and pests are selected. This is usually done by crossing two members of the same

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species which possess dominant alleles of a particular gene, such as long and quick metabolism possessing genes for fast growth and high yields. An example is *Tenera sp.* which possesses the beneficial attributes of Dura and *Pisefera sp.*

Breeding in animals involves the cross breeding of two different animals of the same specie. Animals that are usually crossbred are dogs, cows and fish. Selective breeding has made it possible to produce animals with higher physical strength, better behavior, improved immune system and higher milk production.

4. **Direct Seeding:** This method involves sowing seeds directly into a good soil using special machines such as air seeders, no-till rice direct tillers and so on. Direct seeding is well preferred to transplanting because the seedlings do not undergo the stress accompanied with transplanting, hence they grow and mature faster. Examples of plants that can be directly seeded are: beans, beet, carrot, rice, melon. Pepper, tomatoes.
5. **Genetic Engineering:** Genetic engineering is a method which involves the alteration of an organism's DNA. This method plays a major role in improving the quality and quantity of plants produced.
6. **Proper Soil Management:** Proper soil management involves agricultural practices which improve soil quality. A recent study found that nitrogen fixing trees within critical water and temperature thresholds can increase yields by improving the water-holding capacity of soil and water infiltration

rates [8, 9]. Ploughing is the breaking down of soil particles to allow free flow of air within the soil. Another practice is crop rotation which permits different types of crops to be planted on a piece of land at different planting seasons. This technique improves soil fertility and prevents the accumulation of a plant disease or pest which is peculiar to a particular plant. Addition of manure to soil improves soil texture and structure.

7. **Biological control:** Biological control is a method of pest management in which other organisms which are either predators or pathogens to the pests are introduced to destroy the pests. Examples include the use of snakes and owls to chase after rats in oil palm estates and the use of praying mantis which is a carnivore (feeds on other insects) to attack insect pests such as crickets, grasshoppers and moths.
8. **Bio fortification:** Bio fortification is a process of adding essential nutrients to crop plants during cultivation to make the final products richer in the added nutrients instead of adding such nutrients during food processing.

As much as it is pertinent to embrace technologies which improve the quality and quantity of food production, another aspect to incorporate within the food security concept is the cultural acceptability. This recognizes that the way in which food contributes to the basic needs and well-being of individuals, households and communities, goes far beyond its nutritional adequacy alone, and encompasses enjoyment, as well as the various social, religious, and cultural



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functions that food plays in peoples' lives [10].

Another important aspect that must not be handled with levity is food preservation, because if after producing foods and they are not properly preserved, lots of effort, finance and labor would have been wasted.

Technologies for Food Processing and Preservation

The following are modern technologies for food processing and preservation that will help reduce to a great extent, food loss and wastage:

High Pressure Processing: High pressure processing (HPP) involves the use of hydrostatic pressures between 300 to 700Mpa to destroy microbial food contaminants and inactivate enzymes present in the food for a given period of time. This procedure is usually done after packaging of the food and it is of great advantage because the physicochemical properties of the food and its flavor are not tampered with.

High Pressure Thermal Processing: This method involves the use of both high temperatures (above 60°C) and high pressures (above 600MPa) to inactivate bacterial spores produced by *Bacillus sp* and *Clostridium sp* which thrive in low acid foods.

Pulsed Electric Field Processing: This is a non-thermal method of food preservation that uses short, high voltage of electricity to inactivate microbial cells leaving intact, the nutrients and flavor of the food.

Cool Plasma: Cool plasma consists of charged particles of electrons and ions in their excited state used for food sterilization and surface decontamination.

Ultraviolet Light Processing: Ultraviolet light is used for breaking the chemical bonds of atoms within a microbial DNA in food processing. UV light of 200 to 310nm has been wide used in food industry for the decontamination of food and packaging materials.

Ensuring Food Security in Nigeria

About 795 million people, or every ninth person, is undernourished, including 90 million children under the age of five [11]. The vast majority of them (780 million people) live in the developing regions, notably in Africa and Asia. In particular, sub-Saharan Africa shows high values, with almost 25 per cent of the population undernourished [11]. In absolute terms, the number of people exposed to food insecurity is highest in Southern Asia, with 281 million undernourished people [11].

The current population of Nigeria is 205,232,389 based on projections of the latest United Nations data. The United Nations has also projected that by the end of the year 2050, the population of Nigeria will reach about 401.31 million and that if current figures continue, the Nigerian population will increase to about 728 million by 2100. This is alarming! In the 2019 Global Hunger Index ranking, Nigeria ranks 93rd out of the 117 qualifying countries with a score of 27.9[12]. This indicates a high level of hunger in the country despite the fact that Nigeria is rich in agricultural and other natural resources. This calls for

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an immediate action because with the level of increasing population and conflicts, Nigeria may be in serious food crises in the coming years. Hence, the urgent need to embark on and implement technologies that will help increase food production and enhance food preservation.

The Way Forward In Nigeria As Regards Food Security

- In the northern part of Nigeria where desert encroachment is posing serious threats to farming activities, technologies such as aeroponics, aquaponics and hydroponics which do not require soil should be practiced.
- In the southern part of Nigeria where oil spillage hinder the growth of plants, tissue culture, selective breeding and bio fortification of crops can be done.
- In the eastern and western part of Nigeria, direct seeding, proper soil management and genetic engineering should be practiced.

However, to do the above mentioned, the Federal government of Nigeria and various state governments would release sufficient fund to purchase the required equipment, train specialists and hire more labour which would also be a means of employing more people.

It is not enough for the government of Nigeria to make policies which end up on papers. It is high time they rise up to the challenge of intentionally ensuring food security all over the country.

The National Population Commission of Nigeria with the aid of the Federal

government should come up with strict laws that prohibit giving birth to more than four children.

The Nigerian government should continue to discourage the preferent use of foreign foods and encourage subsistence and commercial farming. Agricultural Engineering could be approved as a professional course in Nigerian universities to encourage students to take up the course. Food wastage can be greatly managed if right preservation techniques are put in place.

Experts from various fields of conflict management from within the country should be pulled together to resolve conflict matters objectively.

Conclusively, food security is possible globally and in Nigeria if right technologies and measures are tenaciously adhered to.

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